

CLAIMS

1. Coplanar-discharge electrode plate (1) for defining discharge regions (3) in a plasma display panel, which comprises:

5 - at least a first and a second array of coplanar electrodes that are coated with a dielectric layer (6) and the general directions of which are parallel, where each electrode (Y) of the first array 10 is adjacent to an electrode (Y') of the second array, is paired with it and is intended to supply a set of discharge regions;

15 - for each discharge region (3), at least two electrode elements (4, 4') that have a common longitudinal axis of symmetry Ox, each connected to an electrode (Y, Y') of a pair,

characterized in that, for each electrode element (4) of each discharge region (3), the point O on the Ox axis being located on what is called an ignition edge 20 of the said electrode element (4) facing the other electrode element (4') of the said discharge region (3) and the Ox axis being directed towards what is called an end-of-discharge edge that delimits the said element (4) on the opposite side from the said discharge edge 25 and is positioned at  $x = x_{cd}$  on the Ox axis, the shape of the said electrode element and the thickness and composition of the said dielectric layer are adapted so that there is an interval  $[x_{ab}, x_{bc}]$  of values of x such that  $x_{bc} - x_{ab} > 0.25x_{cd}$ ,  $x_{ab} < 0.33x_{cd}$  and  $x_{bc} > 0.5x_{cd}$  and 30 such that the surface potential  $V(x)$  increases as a function of x in a continuous or discontinuous manner, without a decreasing part, from a value  $V_{ab}$  to a higher value  $V_{bc}$  within the said  $[x_{ab}, x_{bc}]$  interval when a constant potential difference is applied between the 35 two electrodes supplying the said discharge region, having the appropriate sign so that the said electrode element (4) acts as cathode.

2. Coplanar electrode plate according to Claim 1, characterized in that  $V_{norm}(x') - V_{norm}(x) > 0.001$  whatever

x and x' are, chosen between  $x_{ab}$  and  $x_{bc}$ , such that  $x' - x = 10 \mu\text{m}$ .

3. Coplanar electrode plate according to Claim 1 or 2, characterized in that, defining the normalized 5 surface potential  $V_{\text{norm}}(x)$  as the ratio of the surface potential  $V(x)$  at a level x of the dielectric layer for the electrode element in question to the maximum potential  $V_{0-\text{max}}$  that would be obtained along the Ox axis for an electrode element of infinite width, the 10 normalized surface potential  $V_{\text{norm}}(x)$  increasing from a value of  $V_{n-ab} = V_{ab}/V_{0-\text{max}}$  at the start ( $x = x_{ab}$ ) of the said interval to a value of  $V_{n-bc} = V_{bc}/V_{0-\text{max}}$  at the end ( $x = x_{bc}$ ) of the said interval, then:

$$V_{n-bc} > V_{n-ab}, V_{n-ab} > 0.9, \text{ and } (V_{n-bc} - V_{n-ab}) < 0.1.$$

15 4. Coplanar electrode plate according to any one of the preceding claims, characterized in that, under the same conditions of application of the potential difference between the said electrodes, the maximum potential in the surface region of the dielectric layer 20 that covers the said element and is bounded by the said end-of-discharge edge where  $x = x_{cd}$  and the position  $x = x_{bc}$  is strictly greater than the maximum potential of the surface region of the dielectric layer that covers the said element and is bounded by the said ignition 25 edge where  $x = 0$  and the position  $x = x_{ab}$ .

5. Plasma display panel, characterized in that it is provided with a coplanar electrode plate according to any one of Claims 1 to 4.

6. Coplanar electrode plate according to any one 30 Claims 1 to 4, characterized in that, defining the specific longitudinal capacitance  $C(x)$  of the dielectric layer as the capacitance of a straight elementary strip of this layer, bounded between the said electrode element (4) and the surface of the 35 dielectric layer, positioned at x on the Ox axis, having a length  $dx$  along this Ox axis and a width corresponding to that of the electrode element delimiting the said elementary strip, in order to achieve the said increase in surface potential, this

specific longitudinal capacitance  $C(x)$  of the dielectric layer increases continuously or discontinuously, without a decreasing part, from a value of  $C_{ab}$  at the start ( $x = x_{ab}$ ) of the said interval to a value of  $C_{bc}$  at the 5 end ( $x = x_{bc}$ ) of the said interval.

7. Coplanar electrode plate according to Claim 6, characterized in that the capacitance of the dielectric layer portion that lies between the said element and the surface of this layer and is bounded by the said 10 end-of-discharge edge where  $x = x_{cd}$  and the position  $x = x_{bc}$  is strictly greater than the capacitance of the dielectric layer portion that lies between the said element and the surface of this layer and is bounded by the said ignition edge where  $x = 0$  and the position 15  $x = x_{ab}$ .

8. Coplanar electrode plate according to Claim 7, characterized in that the specific longitudinal capacitance of the dielectric layer in the region lying between  $x = x_{bc}$  and  $x = x_{cd}$  is greater than the specific 20 longitudinal capacitance of the dielectric layer at any other position  $x$  such that  $0 < x < x_{bc}$ .

9. Plasma display panel, characterized in that it is provided with a coplanar electrode plate according to any one of Claims 6 to 8.

25 10. Plasma display panel comprising a coplanar electrode plate (1) according to any one of Claims 1 to 4 and what is called an address electrode plate (2) optionally comprising an array of address electrodes (X) that are coated with a dielectric layer (7) and are 30 oriented and positioned so that each crosses a pair of electrodes of the coplanar electrode plate in one of the said discharge regions, these electrode plates defining between them the said discharge regions and being separated by a distance  $H_c$  expressed in microns, 35 characterized in that, for each discharge region (3) of the said display panel and for each electrode element (4, 4') of this region, letting  $E1(x)$  be the mean thickness expressed in microns and  $P1(x)$  be the mean relative permittivity of

the dielectric layer above the said electrode element (4) at the longitudinal position  $x$  and letting  $E_2(x)$  be the mean thickness expressed in microns and  $P_2(x)$  be the mean relative permittivity of the dielectric layer

5 above the said address electrode (X), or that of the address electrode plate (2) in the absence of the address electrode, the thickness and the permittivity both again being measured at the longitudinal position  $x$  located on an axis which lies on the surface of the address electrode plate and is parallel to the  $Ox$  axis and lying in a plane normal to the surface of the said coplanar electrode plate,

10 the thickness and the composition of these layers are adapted so that the ratio  $R(x) = 1 - [E_1(x)/P_1(x)]/[E_1(x)/P_1(x) + H_c + E_2(x)/P_2(x)]$  increases continuously or discontinuously, without a decreasing part, from a value of  $R_{ab}$  at the start ( $x = x_{ab}$ ) of the said interval to a value  $R_{bc}$  at the end ( $x = x_{bc}$ ) of the said interval.

15 11. Plasma display panel according to Claim 10, characterized in that the width  $W_e(x)$  of the said electrode element is constant within the said range of  $x$  values.

20 12. Plasma display panel according to Claim 11, characterized in that  $R(x') - R(x) > 0.001$  whatever  $x$  and  $x'$  are, chosen between  $x_{ab}$  and  $x_{bc}$ , such that  $x' - x = 10 \mu\text{m}$ .

25 13. Plasma display panel according to Claim 12 or 13, characterized in that  $R_{bc} > R_{ab}$ ,  $R_{ab} > 0.9$ , and  $(R_{bc} - R_{ab}) < 0.1$ .

30 14. Plasma display panel according to any one of Claims 11 to 13, characterized in that the values of  $R(x)$  for any  $x$  such that  $x_{bc} < x < x_{cd}$  are strictly greater than the values of  $R(x)$  for any  $x$  such that  $0 < x < x_{ab}$ .

35 15. Plasma display panel according to Claim 14, characterized in that the values of  $R(x)$  for any  $x$  such that  $x_{bc} < x < x_{cd}$  are strictly greater than the values of  $R(x)$  for any  $x$  such that  $0 < x < x_{ab}$ .

16. Coplanar electrode plate according to any one of Claims 6 to 8, characterized in that, for each electrode element (4) of each discharge region (3), the said dielectric layer (6) has a constant dielectric constant  $P_1$  and a constant thickness  $E_1$  expressed in microns above the said electrode element (4), at least for any  $x$  such that  $x_{ab} < x < x_{bc}$ , and in which, with the following definitions:

- the normalized surface potential  $V_{norm}(x)$ , defined as the ratio of the surface potential  $V(x)$  at a level  $x$  of the dielectric layer for the electrode element in question to the maximum potential  $V_{0-max}$  that would be obtained along the  $Ox$  axis for an electrode element of infinite width, the normalized surface potential  $V_{norm}(x)$  then increasing from a value of  $V_{n-ab} = V_{ab}/V_{0-max}$  at the start ( $x = x_{ab}$ ) of the said interval to a value of  $V_{n-bc} = V_{bc}/V_{0-max}$  at the end ( $x = x_{bc}$ ) of the said interval;

- an ideal width profile of this element, defined by the equation:

$$W_{e-id-0}(x) = W_{e-ab} \exp \{29\sqrt{P_1/E_1} (x-x_{ab}) \times (V_{n-bc}-V_{n-ab})/(x_{bc}-x_{ab})\}$$

where  $W_{e-ab}$  is the total width of the said element, measured at  $x = x_{ab}$  perpendicular to the  $Ox$  axis; and

- a lower limit profile  $W_{e-id-low}$  and an upper limit profile  $W_{e-id-up}$ , defined by the equations:  $W_{e-id-low} = 0.85W_{e-id-0}$  and  $W_{e-id-up} = 1.15W_{e-id-0}$ ,

then, for any  $x$  between  $x_{ab}$  and  $x_{bc}$  inclusive, the total width  $W_e(x)$  of the said element, measured at  $x$  perpendicular to the  $Ox$  axis, is such that:

$$W_{e-id-low}(x) < W_e(x) < W_{e-id-up}(x).$$

17. Coplanar electrode plate according to Claim 16, characterized in that the width  $W_{e-ab}$  is less than or equal to 80  $\mu\text{m}$ .

18. Coplanar electrode plate according to Claim 17, characterized in that the width  $W_{e-ab}$  is less than or equal to 50  $\mu\text{m}$ .

19. Coplanar electrode plate according to any one of Claims 16 to 18, characterized in that the said electrode element (4) is subdivided into two lateral

conducting elements that are symmetrical with respect to the Ox axis and are separate at least in the region where  $x$  lies within the  $[x_{ab}, x_{b3}]$  interval where  $x_{b3}-x_{ab} > 0.7(x_{bc}-x_{ab})$ .

5 20. Coplanar electrode plate according to Claim 19, characterized in that  $x_{b3} = x_{bc}$ .

21. Coplanar electrode plate according to Claim 19 or 20, characterized in that, if Oy is an axis transverse to the Ox axis lying along the ignition edge and 10 letting  $d_{e-p}(x)$  be the distance, measured parallel to the Oy axis at any position  $x$  lying between  $x_{ab}$  and  $x_{bc}$ , between the edges turned towards each other of these two lateral conducting elements, a value  $x = x_{b2}$  lying between  $x_{ab}$  and  $x_{b3}$  exists such that  $d_{e-p}(x) > d_{e-p}(x_{ab})$  15 for any value of  $x$  lying between  $x_{ab}$  and  $x_{b2}$ .

22. Coplanar electrode plate according to Claim 21, characterized in that  $d_{e-p}(x_{ab})$  lies between 100  $\mu\text{m}$  and 200  $\mu\text{m}$ .

23. Coplanar electrode plate according to Claim 22, 20 characterized in that, considering the mean line of each lateral conducting element traced, for a given position  $x$ , at mid-distance between the lateral edges of this lateral element, in the region where  $x_{ab} < x < x_{b2}$ , the tangent at  $x$  to the mean line of this element makes an angle of less than  $60^\circ$  with the Ox axis.

24. Coplanar electrode plate according to Claim 23, characterized in that the said angle lies between  $30^\circ$  and  $45^\circ$ .

25. Coplanar electrode plate according to any one 30 of Claims 19 to 24, characterized in that, if Oy is an axis transverse to the Ox axis lying along the ignition edge and letting  $d_{e-p}(x_{ab})$  be the distance, measured parallel to the Oy axis at a position  $x = x_{ab}$  between the edges turned towards each other of the two lateral 35 conducting elements, the said electrode element comprises a transverse bar called an ignition bar which connects the said lateral conducting elements, one edge of which corresponds to the said ignition edge, and the length of which, measured along the Ox axis, is greater

by a value  $\Delta L_a$  for  $|y|$  lying between 0 and  $y_1$  on either side of the Ox axis than a value  $L_a$  of this length for  $|y|$  lying between  $y_1$  and  $d_{e-p}(x_{ab})/2$  on either side of the Ox axis.

5 26. Plasma display panel, characterized in that it is provided with a coplanar electrode plate according to any one of Claims 16 to 25.

10 27. Plasma display panel comprising a coplanar electrode plate (1) according to any one of Claims 1 to 4 and an address electrode plate (2) comprising:

15 - an array of address electrodes (X) that are coated with a dielectric layer (7) and are oriented and positioned so that each crosses a pair of electrodes of the coplanar electrode plate in one of the said discharge regions;

20 - an array of parallel barrier ribs (16), each being placed between two adjacent address electrodes at a distance  $W_c$  from two other adjacent barrier ribs, these electrode plates defining between them the said discharge regions and being separated by a distance  $H_c$ , characterized in that the said dielectric layer (6) has a homogeneous composition and a constant thickness above the said electrode element (4), at least for any  $x$  such that  $x_{ab} < x < x_{bc}$ , and in that, for each 25 discharge region (3) of the said display panel and for each electrode element (4, 4') of this region, the said electrode element (4) is subdivided into two lateral conducting elements of constant width  $W_{e-p0}$  that are symmetrical with respect to the Ox axis and are 30 separate in the region where  $x$  lies within the  $[x_{ab}, x_{bc}]$  interval, and in that, if Oy is an axis transverse to the Ox axis lying along the ignition edge and letting  $d_{e-p}(x)$  be the distance, measured parallel to the Oy axis at any position  $x$  lying between  $x_{ab}$  and  $x_{bc}$ , 35 between the edges turned towards each other of these two lateral conducting elements,  $d_{e-p}(x)$  increases in a continuous or discontinuous manner as a function of  $x$  in the said  $[x_{ab}, x_{bc}]$  interval, and in that, considering the mean line of each lateral conducting element

traced, for a given position  $x$ , at mid-distance between the lateral edges of this lateral element, in the region where  $x_{ab} < x < x_{bc}$ , the tangent at  $x$  to the mean line of this element makes an angle of between  $20^\circ$  and 5  $40^\circ$  with the  $Ox$  axis, and in that  $d_{e-p}(x_{ab}) \leq 350 \mu\text{m}$ .

28. Plasma display panel according to Claim 27, characterized in that  $200 \mu\text{m} \leq d_{e-p}(x_{ab}) \leq 350 \mu\text{m}$  and in that the said electrode element comprises a transverse bar called an ignition bar which connects the said 10 lateral conducting elements, one edge of which corresponds to the said ignition edge, and the length of which, measured along the  $Ox$  axis, is greater by a value  $\Delta L_a$  for  $|y|$  lying between 0 and  $y_1$  on either side of the  $Ox$  axis than a value  $L_a$  of this length for  $|y|$  15 lying between  $y_1$  and  $d_{e-p}(x_{ab})/2$  on either side of the  $Ox$  axis.

29. Plasma display panel according to Claim 28, characterized in that, if  $W_a$  is the width of the said ignition bar measured along the  $Oy$  axis,

20        - if  $L_a < 2W_{e-p0}$ ,  $\Delta L_a > 2W_{e-p0} - L_a$   
          - if  $L_a \geq 2W_{e-p0}$ ,  $\Delta L_a > 0.2L_a$ .

30. Plasma display panel comprising a coplanar electrode plate (1) according to any one of Claims 1 to 4 and an address electrode plate (2), comprising:

25        - an array of address electrodes (X) that are coated with a dielectric layer (7) and are oriented and positioned so that each crosses a pair of electrodes of the coplanar electrode plate in one of the said discharge regions;

30        - an array of parallel barrier ribs (16), each being placed between two adjacent address electrodes, these electrode plates defining between them the said discharge regions and being separated by a distance  $H_c$ , characterized in that the said dielectric layer (6) has 35 a homogeneous composition and a constant thickness above the said electrode element (4), at least for any  $x$  such that  $x_{ab} < x < x_{bc}$ , and in that, if  $W_c$  is the distance between two adjacent barrier ribs, for each discharge region (3) of the said panel and for each

electrode element (4, 4') of this region, the said electrode element (4) is subdivided into two lateral conducting elements of constant width  $W_{e-p0}$ , the distance  $d_{e-p0}$  between the edges of which that are 5 turned towards each other is constant and greater than  $W_c$ , which elements are symmetrical with respect to the Ox axis and separate in the region where  $x$  lies within the  $[x_{ab}, x_{bc}]$  interval, and in that the said electrode element comprises:

10 - a transverse bar called an ignition bar, the width of which is greater than or equal to  $W_c$ , the length of which measured along the Ox axis is  $L_a$  and one edge of which corresponds to the said ignition edge;

15 - a transverse bar called a discharge stabilization bar, the width of which is greater than or equal to  $W_c$ , the length of which, measured along the Ox axis, is  $L_s$ , and one edge of which corresponds to the said end-of-discharge edge; and

20 - at least one intermediate transverse bar, the width of which is greater than or equal to  $W_c$  and the position of which, along the Ox axis, lies entirely within the  $[x_{ab}, x_{bc}]$  interval over its entire length  $L_b$ ; and in that  $L_b \leq L_a < L_c$ .

25 31. Display panel according to Claim 30, characterized in that, with one of the edges of the intermediate transverse bar being at a distance  $d_1$  from the said discharge stabilization bar and the other edge being at a distance  $d_2$  from the said ignition bar, then 30  $d_2/2 < d_1 < d_2$ .

32. Display panel according to Claim 31, characterized in that:

$$3 \times \max(L_a, L_b) < L_s > 5 \times \max(L_a, L_b).$$

33. Plasma display panel according to any one of 35 Claims 5, 9, 10-15 and 26-32, characterized in that it comprises the said coplanar electrode plate (1) and an address electrode plate defining between them the said discharge regions (3) and in that, for each discharge region and for each electrode element, if  $W_{e-ab}$  is the

width of the said electrode element, measured along the Ox axis at the position  $x = x_{ab}$  at the start of the said  $[x_{ab}, x_{bc}]$  interval, the said electrode element preferably comprises a transverse bar called an 5 ignition bar, one edge of which corresponds to the said ignition edge and the length of which, measured along the Ox axis, is such that:  $W_{e-ab} \leq L_a < 80 \mu\text{m}$ .

34. Plasma display panel according to Claim 33, comprising an array of parallel barrier ribs (16) 10 placed between the said electrode plates (1, 2) at a distance  $W_c$  from one another, perpendicular to the general direction of the said coplanar electrodes, characterized in that, if Oy is an axis transverse to the Ox axis lying along the ignition edge and if  $W_a$  is 15 the width of the said transverse ignition bar, measured along the Oy axis, then:

$$W_c - 60 \mu\text{m} < W_a \leq W_c - 100 \mu\text{m}.$$

35. Plasma display panel according to Claim 33, comprising an array of parallel barrier ribs (16) 20 placed between the said electrode plates (1, 2) at a distance  $W_c$  from one another, perpendicular to the general direction of the said coplanar electrodes, characterized in that, if Oy is an axis transverse to the Ox axis lying along the ignition edge, if  $W_a$  is the 25 width of the said transverse ignition bar measured along the Oy axis and if  $W_{a-min}$  corresponds to the width beyond which the said barrier ribs cause a substantial reduction in the surface potential of the dielectric layer above the said element, the said transverse 30 ignition bar comprises:

- a central region  $Z_{a-c}$  for which, at any point  $|y| \leq W_{a-min}/2$ , the distance, along the Ox axis, between the ignition edges of the two electrode elements of the said discharge region is constant and equal to  $g_c$ ; and

35 - two lateral regions  $Z_{a-p1}$ ,  $Z_{a-p2}$  on either side of the central region  $Z_{a-c}$ , for which, at any point  $|y| > W_{a-min}/2$ , the distance, along the Ox axis, between the ignition edges of the two electrode elements of the

said discharge region decreases continuously from the value  $g_c$ .

36. Plasma display panel according to any one of Claims 5, 9, 10-15 and 26-35, characterized in that it 5 comprises supply means suitable for generating, between the coplanar electrodes, various pairs of series of voltage pulses called sustain pulses, each with a constant plateau.